Journal of
Economics and Political Economy
www.kspjournals.org
Volume 6 March 2019 Issue 1

# Searching for the credibility of monetary policy in Turkey: Evidence from structural VAR analysis

*By* Buket ALKAN †

**Abstract.** A relationship between the macro shocks and the long-term inflation expectations leads to questioning the credibility of a central bank. This paper investigates the credibility of the Central Bank of Turkey by analyzing the anchoring effect of the long-term inflation expectations by using the uncertainty indicator. We conduct the analysis with the structural VAR method using survey-based inflation expectations data as well as economic uncertainty index data developed for the Turkish economy. Our results provided evidence in favor of the existing de-anchoring process and imply that the monetary policy is not fully credible in Turkey during the period under investigation.
**Keywords.** Inflation expectations, Structural VAR, Credibility, Anchoring, The Turkish economy, Uncertainty.
**JEL.** E52, E58.

## 1. Introduction

The monetary theory argues that long-term inflation expectations do not respond to macroeconomic shocks if the central banks are fully credible (Gürkaynak *et al.,* 2010). As known from the credibility theory, the market participants will choose to follow the targets and the explanations of the central banks in the long-term even if the short-term inflation expectations may diverge from its anchored level because of a shock that hits the economy, since the shocks are informative for the short-term outlook of the economic agents.

Because there is a strong relationship between the anchoring of inflation expectations and the credibility of monetary policy, many researchers focused on the question of how the inflation expectations are formed and whether the macro shocks on long-term inflation expectations are persistent or short-lived. For the former question, the model of Bomfim & Rudebusch (2000) has played an important role in the analysis. According to their inflation expectation model, the monetary policy is fully credible in the long-run if the inflation expectations are only anchored to the target rate of inflation released by the central banks and not responsive to the previous period of the actual inflation rate. On the other hand, the model of Gürkaynak *et al.,* (2010) gained importance for the latter question and they suggested that monetary policy is fully credible when the long-term

† Individual Researcher, Istanbul, Turkey.
☎. (351) 217 21 42 48 ✉. bukete@gmail.com

inflation expectations do not respond to macro shocks even if the shocks are effective on the short-term inflation expectations.

Two models mentioned above assumes that there is no any intrinsically linkage between short- and long-term inflation expectations which means the macro shocks hit the inflation expectations would die in the long run even if it might have a significant role in the short-run. However, some economists following Jochmann *et al.*, (2010) suggested that the spill-over effect from short-run inflation expectations to the long-run ones may be a sign of the de-anchoring process in the expectations. In other words, the long-run inflation expectations may respond to a change in the short-run inflation expectation dynamics which may be affected by a macro shock hits the economy.

This research has focused on the question of whether the monetary policy is credible or not in Turkey. In order to search for that, we employed structural vector autoregressive (SVAR) method, made popular by Sims (1980), in order to capture the anchoring or de-anchoring process of inflation expectations. The main advantage of the SVAR method is that the restrictions on the reduced-form VAR model can be provided by the economic theory. Therefore, we can capture the dynamic impacts of the macroeconomic shocks and short-term inflation expectations on the short- and long-term inflation expectations, respectively. In the literature, linear regression models are generally used for investigating the anchoring effect. The use of the SVAR model is one of the outstanding contributions of this study.

Our analysis has some other advantages in comparison to the empirical counterparts. First, we have used the real economic uncertainty data instead of the macro news shocks that the counterparts employed. Macro news shocks are defined as the deviations of the real values of the macroeconomic indicators from their expected values before the announcements On the other hand, the uncertainty is defined as the difference between the actual value of the macro variables and their expected values. Hence, the variance of a variable might be thought as the indicator of uncertainty. With this motivation, it is desired to investigate whether the uncertainty is one of the obstacles to long-term inflation expectations to anchor to the inflation targets. By using inflation expectations and uncertainty indicator, the main question of the study is whether the monetary policy is credible or not in Turkey.

Our empirical analysis revealed findings in favor of de-anchoring process in Turkey. According to the findings, we reached that the uncertainty has a direct impact on both short-and long-term inflation expectations during the period under investigation. The response of short-term inflation expectations to the uncertainty is found greater in comparison to the long-term ones, as expected. This finding revealed that the monetary policy is not fully credible in Turkey as supporting previous studies such as Çiçek *et al.*, (2011), Çiçek & Akar (2014) among others. Moreover, we searched for indirect effect of uncertainty on long-term

inflation expectations through short-term inflation expectations and the findings revealed that indirect effect is much more than the direct effect.

The reminder of the paper proceeds as follows. Section 2 mentions the anchoring effect and the credibility of monetary policy by giving the theoretical perspective with the literature and focusing on Turkey for credibility. Section 3 describes our survey-based monthly data for short- and long-term inflation expectations and uncertainty data. Section 4 gives the framework of structural VAR model. Section 5 displays our estimations and empirical results. Finally section 6 concludes.

## 2. Anchoring effect and the credibility of monetary policy

The literature on which we base our paper indicates that there is a strong relationship between long-term inflation expectations and the central bank credibility. In this context, the central bank has a special attitude toward the future decisions of the economic units within the economy.

### 2.1. Theoretical perspective and the literature

The Phillips-curve is a very old approach in economics on forecasting inflation, and it gives useful information about monetary policy decision making (Yellen, 2015). In the New Keynesian approach, the prices and wages are assumed to be sticky in the short-run which enables the central banks to affect both the inflation rates and the output level. But in the long run, the monetary policy will not have an impact on output level since the economic agents adjust their prices and wages because of the rational expectations. Therefore, long-run inflation expectations of the economic agents play a crucial role in the New Keynesian Phillips curve model. In order to anchor the long-run inflation expectations, the central banks use several instruments and methods such as implicit and explicit inflation targets, inflation forecasts, reports on inflation and financial stability, among others, since the theory argues that well-anchored inflation expectations are supportive for stabilizing the actual inflation rates (Mehrotra & Yetman, 2014).

In recent years, if you ask any central banker what is the most important factor in monetary policy, the answer is more likely to be the inflation expectations (Kara & Küçük-Tuğer, 2010). The monetary transmission mechanism might be effective if the long-term inflation expectations are well anchored to the implicit or explicit inflation targets of the central banks. Because of this vital importance in the transmission mechanism, the central banks are heavily focusing on inflation expectations while discussing their policies. It is commonly accepted that the well-anchored long-term inflation expectations are not responsive to the short-run oriented macroeconomic shocks, while the short-term inflation expectations are. Therefore, a relationship between the macro shocks and the long-term

inflation expectations leads to a questioning the credibility of the central bank. Following the works of Bomfim & Rudebusch (2000) and Gürkaynak *et al.,* (2010), many economists focused on the behavior of the long-term inflation expectations and hence the central bank credibility by employing different methodologies and data.

The anchoring effect is firstly defined by Bomfim & Rudebusch (2000). The authors assumed that the long-run inflation expectations ($\pi^e_{t|t+1}$) are a weighted average of the current targets ($\pi^T_t$) of the central banks and last period's inflation rate ($\bar{\pi}_{t-1}$) $[\pi^e_{t|t+1} = \lambda_t \pi^T_t + (1-\lambda_t)\bar{\pi}_{t-1}]$. According to the authors, the anchoring effect can be captured by the $\lambda_t$ coefficient which may take values between 0 and 1. A central bank might be defined as fully credible if economic agents do not take the last period's inflation rate into account but do the current target rates while forming their inflation expectations. In this situation, the $\lambda_t$ coefficient will be equal to 1. If $\lambda_t = 0$ that means monetary policy has no credibility and the agents of the economy do not follow the target rates of the central bank.[1] On the other hand, Gürkaynak *et al.,* (2010) defined the anchoring effect as the insensibility of long-term inflation expectations to the macroeconomic shocks even if short-term inflation expectations respond to them. A vast majority of literature use regression analysis to investigate the impact of macroeconomic news shocks on long-term inflation expectations by following this approach. There is a growing literature that uses high-frequency market-based data to measure the inflation expectations and examines the anchoring effect by investigating the relationship between expectations and macroeconomic variables (see Beechy *et al.,* 2011, Galati *et al.,* 2011 etc.). New types of studies which work to capture the effect of pass-through from short-term inflation expectations to long-term ones by using break-even inflation data begin to be added to the literature. Jochmann *et al.,* (2010) focused on the pass-through coefficient between short- and long-term inflation expectations. In that study, daily U.S. data was used and it showed that when an increasing shock occurs on short-term inflation expectations, resulted in a rise in long-term inflation expectations. This coefficient varies over time, so does the level of short-term inflation expectations level. The empirical results indicate that inflation pass-through coefficient depends on the changes in short-term inflation expectations. By following Jochmann *et al.,* (2010), some other authors investigated the same pass-through effect by using the market-based daily data like as Gefang *et al.,* (2012), Lemke & Strohsal (2013) and Hachula & Nautz (2018).

### 2.2. The credibility in Turkey

Turkey implemented implicit inflation targeting (IT) regime from 2002 to 2005 and after 2006 has adopted to explicit targeting regime. The literature regarding the anchoring effect of inflation expectations and also measuring credibility over this effect is not sufficiently grown up in Turkey. Başkaya, Kara & Mutluer (2008) search for the relationship

between the inflation expectations and some economic developments like exchange rate and economic activity for Turkey. The empirical results state the fact that there is no remarkable relationship between the industrial production gap and the inflation expectations in the pre-IT period. However, a rise in the production gap is associated with an increase in the expected inflation in the post-IT period. And the results also reveal that an increase in the depreciation of Turkish Lira has led to higher inflation expectations. Çiçek *et al.,* (2011) investigated the inflation targeting regime process of Turkey through the instrument of the degree of anchoring of inflation expectations to the target rates. The authors emphasize that the gap between inflation expectations and the inflation target which was announced by monetary authority is a good proxy for the credibility of CBRT. In the paper which time-varying vector auto-regressive model has been used, the coefficients signed a high degree anchoring effect until May 2006 and after financial volatility in May 2006, relatively lower degree until November 2008. Following Bomfim & Rudebusch (2000), the authors calculated lambda parameters for different dates. Maximum lambda parameter was calculated 0,9130 between Jan-2006 and May-2006, the minimum parameter was calculated 0,7849 between July 2008 – Nov 2008. Çiçek & Akar (2014) also define a gap between inflation expectations and target inflation. The authors investigate the dynamic behaviors of this gap. Quantile auto-regression approach was used in the research to question the credibility of monetary policy. The authors reached strong evidence in favor of impaired credibility of CBRT. They drew an inference that economic agents take into account the actual inflation rather than the target inflation while they are forming their expectations.

In this paper, we focused on the question of whether the monetary policy is credible or not in Turkey, by employing the SVAR method which helped us to search for the anchoring effect. We used monthly survey-based data (obtained from the CBRT). We analyzed the response of inflation expectations to economic uncertainty index which is quantified by Yildirim & Alkan (2018).

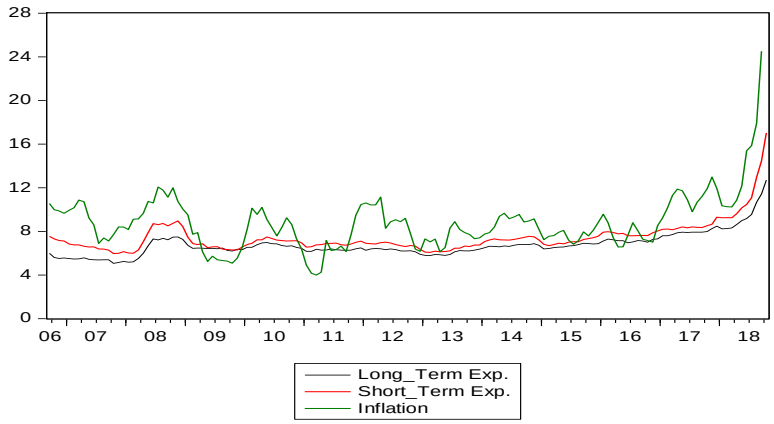
## 3. Data

### 3.1. Inflation expectations

In the empirical analyses, typically two different measurements of inflation expectations are used. One of them is survey-based inflation expectations which covers the expectations of financial institutions and academicians, and reflect beliefs of these forecasters. Berk & Hebbink (2006), Tsenova (2012) and Nautz *et al.,* (2016) are the researchers who used the survey-based data. The other kind measurement is the financial market-based expectations the so-called break-even inflation rates (BEIRs). The BEIR provides an estimate of expected inflation at which an investor would be neutral between holding either type of bond. This type of proxy calculated from the difference between the inflation-linked bonds and nominal bonds. Bauer (2015), Autrup & Grothe (2014) and Garcia & Werner

(2018) can be considered as the examples of the studies which uses market-based data. The data on Turkey's inflation-linked bond yields and nominal bond yields available 5 years and 10 years ahead bond. On the other hand, it should not be forgotten that as a developing country for Turkey, especially 10 years period is too long to talk about its effect on pricing behavior and 5 year horizon is very long period for mimicking the short-time inflation expectations. The BEIRs have an advantage by having high-frequency but they also carry two risks: information on risk premia as well as the changes related to the trading conditions. The studies investigating the impact of macro-shocks on long-term inflation expectations by using market-based daily data focus on very short-run since they accept the macro-surprises only occur on the days of the data releases.

In this study, we obtained data from the Expectation Survey (ES) of the CBRT for inflation expectations in two horizons with monthly frequency. The survey asks about different horizons of inflations expectations. We use 12 months ahead ($\pi_S^e$) and 24 months ahead ($\pi_L^e$) inflation expectations for short- and long-term inflation expectations, respectively.[2] 12 months ahead inflation expectation is available from 2001:08 and 24 months ahead inflation expectation is available from 2006:04. We started our analysis period from 2006:04. By using survey-data, we focus on the response of the inflation expectations to uncertainty shocks not in the very short-run, but in the short-run. Graph 1 plots the timeline graph of the short- and long-term inflation expectations and actual year-on-year changes in the Consumer Price Index (CPI).

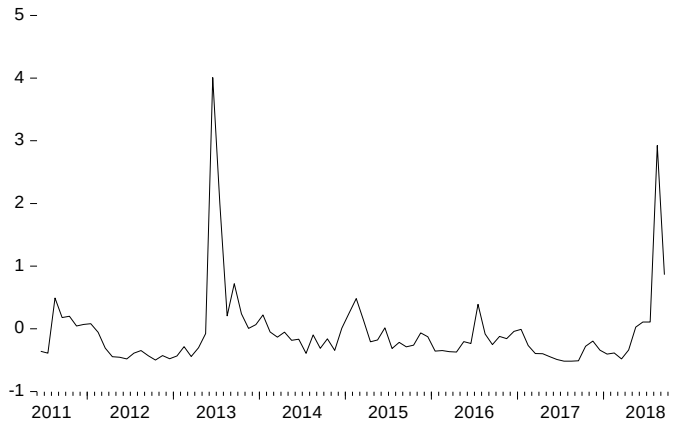



**Graph 1.** *Short- and Long-Term Inflation Expectations and Actual Inflation Rate*

### 3.2. Uncertainty shocks

As an open economy, Turkey has been sensitive to the financial market shocks. The deterioration of the recent (August 2018) exchange rate shocks on pricing behavior and the inflation expectations can be considered as a confirmation of this. With this motivation, we decided to use the uncertainty shocks as the proxy for the macroeconomic shocks instead of macroeconomic-news shocks which are used by Gürkaynak, *et al.*, (2010) and the subsequent studies. From this point of view, we used Economic Uncertainty Index (EUI) quantified by Yildirim & Alkan (2018) [3] to

investigate the response of inflation expectations to uncertainty shocks and also the anchoring effect. This index composes of the individual volatility series of $/□ exchange rate, stock market (BIST 100 index) and two-year bond yield, in daily frequencies. The volatilities of the exchange rate, the stock market and bond yield are generated by using Generalized Autoregressive Conditional Heteroscedasticity (GARCH) method (Yildirim & Alkan, 2018). Then three sub-indicators are aggregated by adding them with equal weights. In the literature of uncertainty, the volatility of an indicator can be interpreted as the uncertainty of it. Besides, the difference between the realization and the expectation of a macroeconomic indicator is also interpreted as the uncertainty of that indicator. It is clear that the forecasters' forecasts may deviate from the realities if their mind is blurred about the future which means the uncertainty exists in real life. Indeed when viewed from the uncertainty framework, both indicators are suitable to be representative of uncertainty. Hence, as an aggregate indicator EUI can be used to measure the uncertainty effect. We used the monthly average of daily series to conduct a monthly analysis. The timeline graph of monthly EUI is shown in Graph 2.




**Graph 2.** *Economic Uncertainty Index (EUI)*

In this study, we used the augmented Dickey-Fuller (ADF) test to search for the unit root. The results of unit root estimations are presented in Table 1 and they refer that both short- and long-term inflation expectations are stationary at first difference of time series and the uncertainty has a stationary time series at the level.

**Table 1.** *Stationarity of Inflation Expectations and Uncertainty*

| | N | C | C&T |
|---|---|---|---|
| $\pi^e_{S,t}$ | 1.402267 | 1.650597 | 0.800378 |
| $\pi^e_{L,t}$ | 1.836593 | 1.546968 | 0.514070 |
| $m_t$ | -5.985158* | -5.962575* | -5.979085* |
| $\Delta\pi^e_{S,t}$ | -4.359568* | -4.489449* | -4.884862* |
| $\Delta\pi^e_{L,t}$ | -6.270558* | -6.498660* | -6.748821* |
| $\Delta m_t$ | -11.60760* | -11.56945* | -11.53355* |

**Note:** * indicates rejection of the null hypothesis of a unit root at 1% level of significance.

Additionally, Table 2 provides some descriptive statistics about the data we have used.

**Table 2.** *Descriptive Statistics*

| | Mean | Max | Min | Std. Dev. | JB | Obs. |
|---|---|---|---|---|---|---|
| $(\pi_L^e)$ | 6.7030 | 11.42 | 5.06 | 0.9763 | 195.71*** | 150 |
| $(\pi_S^e)$ | 7.3657 | 14.46 | 5.96 | 1.1971 | 858.59*** | 150 |
| $(\Delta\pi_L^e)$ | 0.0377 | 1.13 | -0.55 | 0.198 | 406.48*** | 149 |
| $(\Delta\pi_S^e)$ | 0.0480 | 1.89 | -0.99 | 0.3037 | 1085.54*** | 149 |
| $(m)$ | -0.0173 | 3.8500 | -0.5676 | 0.7073 | 1895.53*** | 150 |

**Note:** *** indicates significance at the 1-percent level, ** at the 5-percent level, and * at the 10-percent level.

## 4. Structural VAR methodology

In this section, we define the structural vector autoregressive (SVAR) method in order to search for the anchoring effect. SVAR method argues that there is a contemporaneous interdependence between the economic uncertainty $(m)$, short-term inflation expectations $(\pi_S^e)$ and long-term inflation expectations $(\pi_L^e)$ regardless of the theory. Additionally, the method allows lagged values to be in the equations in order to capture the long-term relationship. For simplicity, we just allowed one lag in each model in the following equations. Hence, the structural VAR presentation of the variables can be shown as follows:

$$m_t = \vartheta_0 + \vartheta_1\pi^e_{S,t} + \vartheta_2\pi^e_{L,t} + \vartheta_3 m_{t-1} + \vartheta_4\pi^e_{S,t-1} + \vartheta_5\pi^e_{L,t-1} + u_t^m \quad (1)$$

$$\pi^e_{S,t} = \delta_0 + \delta_1 m_t + \delta_2\pi^e_{L,t} + \delta_3 m_{t-1} + \delta_4\pi^e_{S,t-1} + \delta_5\pi^e_{L,t-1} + u_t^S \quad (2)$$

$$\pi^e_{L,t} = \gamma_0 + \gamma_1 m_t + \gamma_2\pi^e_{S,t} + \gamma_3 m_{t-1} + \gamma_4\pi^e_{S,t-1} + \gamma_5\pi^e_{L,t-1} + u_t^L \quad (3)$$

In Equations 1, 2 and 3, we may see that each variable has a contemporaneous effect on the other variables. This kind of contemporaneous relationship may cause an endogeneity problem in the models and therefore the estimated coefficients might be biased in such a case. In other words, the ordinary least squares estimates of the coefficients of all regressors will be inconsistent if even one of the regressors is endogenous. In order to prevent the endogeneity problem, the variables must be defined by just lagged values rather than the contemporaneous ones. Hence, the reduced-form version of the VAR method might be helpful to solve this problem. In order to reach the reduced-form presentation of the VAR, we first need to move the contemporaneous variables to the left-hand side of the equations.

$$m_t - \vartheta_1\pi^e_{S,t} - \vartheta_2\pi^e_{L,t} = \vartheta_0 + \vartheta_3 m_{t-1} + \vartheta_4\pi^e_{S,t-1} + \vartheta_5\pi^e_{L,t-1} + u_t^m \quad (4)$$

$$-\delta_1 m_t + \pi^e_{S,t} - \delta_2\pi^e_{L,t} = \delta_0 + \delta_3 m_{t-1} + \delta_4\pi^e_{S,t-1} + \delta_5\pi^e_{L,t-1} + u_t^S \quad (5)$$

$$-\gamma_1 m_t - \gamma_2\pi^e_{S,t} + \pi^e_{L,t} = \gamma_0 + \gamma_3 m_{t-1} + \gamma_4\pi^e_{S,t-1} + \gamma_5\pi^e_{L,t-1} + u_t^L \quad (6)$$

The matrix form of the Equations 4, 5 and 6 can be shown as in Equation 7.

$$\begin{bmatrix} 1 & -\vartheta_1 & -\vartheta_2 \\ -\delta_1 & 1 & -\delta_2 \\ -\gamma_1 & -\gamma_2 & 1 \end{bmatrix} \begin{bmatrix} m_t \\ \pi^e_{S,t} \\ \pi^e_{L,t} \end{bmatrix} = \begin{bmatrix} \vartheta_0 \\ \delta_0 \\ \gamma_0 \end{bmatrix} + \begin{bmatrix} \vartheta_3 & \vartheta_4 & \vartheta_5 \\ \delta_3 & \delta_4 & \delta_5 \\ \gamma_3 & \gamma_4 & \gamma_5 \end{bmatrix} \begin{bmatrix} m_{t-1} \\ \pi^e_{S,t-1} \\ \pi^e_{L,t-1} \end{bmatrix} + \begin{bmatrix} u^m_t \\ u^S_t \\ u^L_t \end{bmatrix} \quad (7)$$

We can rewrite Equation 7 by using the structural form parameter matrix as follows;

$$\begin{bmatrix} 1 & -\vartheta_1 & -\vartheta_2 \\ -\delta_1 & 1 & -\delta_2 \\ -\gamma_1 & -\gamma_2 & 1 \end{bmatrix} \begin{bmatrix} m_t \\ \pi^e_{S,t} \\ \pi^e_{L,t} \end{bmatrix} = \begin{bmatrix} \vartheta_0 \\ \delta_0 \\ \gamma_0 \end{bmatrix} + \begin{bmatrix} \vartheta_3 & \vartheta_4 & \vartheta_5 \\ \delta_3 & \delta_4 & \delta_5 \\ \gamma_3 & \gamma_4 & \gamma_5 \end{bmatrix} \begin{bmatrix} m_{t-1} \\ \pi^e_{S,t-1} \\ \pi^e_{L,t-1} \end{bmatrix} + \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^m_t \\ \varepsilon^S_t \\ \varepsilon^L_t \end{bmatrix} \quad (8)$$

Equation 8 can be written in the matrix form as follows;

$$Ay_t = A_0 + A_1 y_{t-1} + B\varepsilon_t \quad (9)$$

In equation 9, the dependent variable matrix is $y_t = \{m_t, \pi^e_{S,t}, \pi^e_{L,t}\}$, the constant matrix is $A_0 = \{\vartheta_0, \delta_0, \gamma_0\}$, the lagged values matrix is $y_{t-1} = \{m_{t-1}, \pi^e_{S,t-1}, \pi^e_{L,t-1}\}$, the lagged values coefficient matrix is $A_1$, the error term matrix is $\varepsilon_t = \{\varepsilon^m_t, \varepsilon^S_t, \varepsilon^L_t\}$ and the error term structural form parameter matrix is $B$. Therefore, the $A$, $A_1$ and $B$ matrix can be shown as follows;

$$A = \begin{bmatrix} 1 & -\vartheta_1 & -\vartheta_2 \\ -\delta_1 & 1 & -\delta_2 \\ -\gamma_1 & -\gamma_2 & 1 \end{bmatrix} and\ A_1 = \begin{bmatrix} \vartheta_3 & \vartheta_4 & \vartheta_5 \\ \delta_3 & \delta_4 & \delta_5 \\ \gamma_3 & \gamma_4 & \gamma_5 \end{bmatrix} and\ B = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

If we multiply both sides with the inverse matrix of $A$ matrix ($A^{-1}$), we can get the reduced-form presentation of the structural VAR as shown in Equation 11.

$$A^{-1}Ay_t = A^{-1}A_0 + A^{-1}A_1 y_{t-1} + A^{-1}B\varepsilon_t \quad (10)$$

$$y_t = A^*_0 + A^*_1 y_{t-1} + A^{-1}B\varepsilon_t \quad (11)$$

Here, $A^*_1$ is a $3 \times 3$ coefficient matrix where $A^*_1 = A^{-1}A_1$, $B$ is a structural form parameter matrix, $\varepsilon_t$ is a $3 \times 1$ vector of unobserved structural shocks, with $\varepsilon_t \sim (0, I_K)$. We may see that the structural innovation is orthonormal; that is, the structural covariance matrix, $\Sigma_\varepsilon = E(\varepsilon_t \varepsilon_t^{'})$, is the identity matrix, $I_K$. The innovations of the reduced form model, $u_t$, can be expressed as a linear combination of the structural shocks, $\varepsilon_t$, as shown in Equation 13.

$$u_t = A^{-1}B\varepsilon_t \quad (12)$$

$$u_t = S\varepsilon_t \quad (13)$$

$$\Sigma_{\varepsilon} = SS' \quad (14)$$

where $S = A^{-1}B$ . The orthonormal innovations, $\varepsilon_t$ , ensure the identifying restriction on $A$ and $B$.

## 5. Estimations and empirical findings

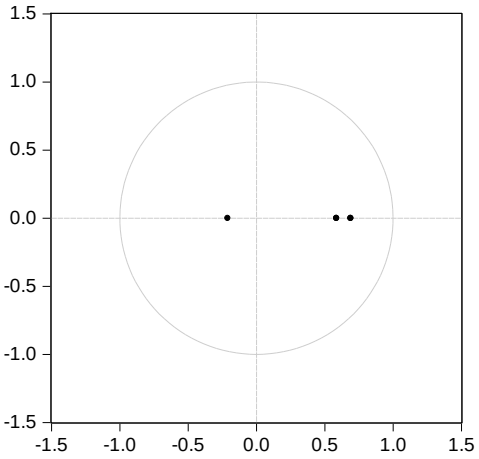
In line with the stationary properties of the variables, we employed the VAR model for the level of uncertainty, first difference of short- and long-term inflation expectations, i.e. $y_t = \left(m_t, \Delta\pi^e_{S,t}, \Delta\pi^e_{L,t}\right)$. We used Akaike and Schwarz information criterions for lag order selection and determined the lag length order as one.[4]

We began with estimating the structural parameters of the S matrix of the SVAR model and defined the relationship between the inflation expectations and uncertainty by the following structural form equation in line with theory:

$$\begin{bmatrix} u_t^m \\ u_t^S \\ u_t^L \end{bmatrix} = \begin{bmatrix} s_{11} & 0 & 0 \\ s_{21} & s_{22} & 0 \\ 0 & 0 & s_{33} \end{bmatrix} . \begin{bmatrix} \varepsilon_t^m \\ \varepsilon_t^S \\ \varepsilon \end{bmatrix}$$

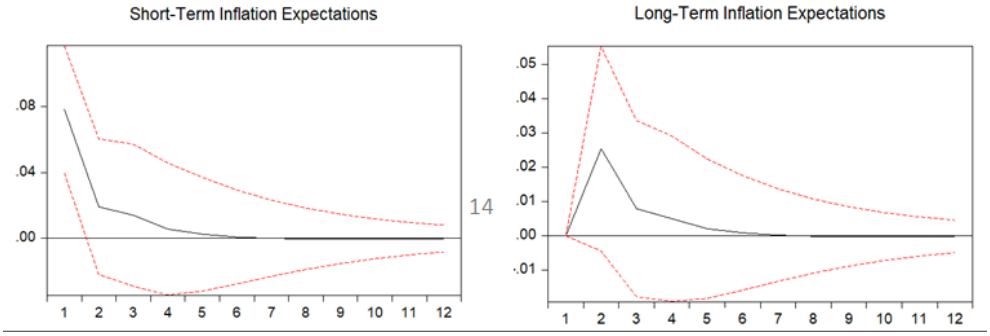
SVAR method gives the opportunity to identify the structure for variables to react contemporaneously to other variables in the model. However, if we use Cholesky decomposition, we would not be able to allow for rich simultaneous relations between the variables. In our analysis, we aimed to test the impact of uncertainty shocks on short- and long-term inflation expectations and in the light of theory explained in the previous sections, we assumed that the short-term inflation expectations can respond the uncertainty shocks ($s_{21} > 0$). On the other hand, in line with anchoring theory, we expect the long-term inflation expectations will not be affected contemporaneously by the uncertainty shocks ($s_{31} = 0$). Furthermore, we assumed that a shock to short-term inflation expectations have no contemporaneous impact on long-term ones ($s_{32} = 0$). Finally all variables can be affected by their own shocks ($s_{11} = s_{22} = s_{33} \neq 0$).

Graph 3 shows the stationary of the estimated model. The estimated SVAR is stationary if the all roots have modulus less than one and lie inside the unit circle.




**Graph 3.** *Inverse Roots of AR Characteristic Polynomial*

The impulse-response analysis helps us to get further evidences on the dynamic responses of the inflation expectations to the shocks of uncertainty. While constructing confidence bands for impulse-responses, we used 1000 Monte Carlo replications following the literature. Graph 4 shows the responses of short- and long-term inflation expectations to uncertainty shocks while Graph 5 plots the responses of them to short-term inflation expectation shocks.

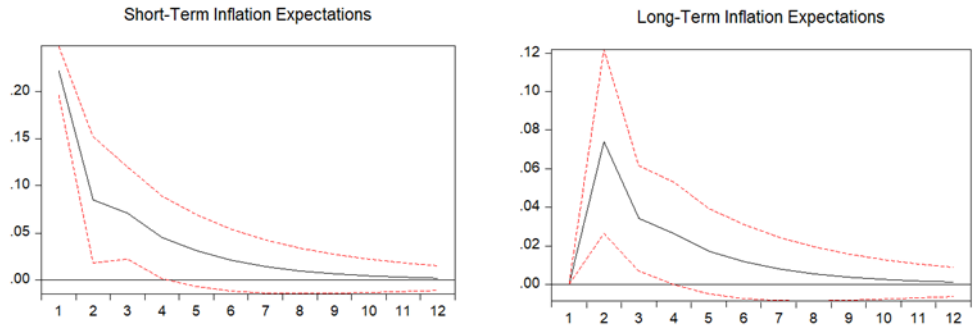



**Graph 4**. *Responses to Positive Uncertainty Shock in SVAR Model*

Graph 4 plots the dynamic effects of uncertainty shocks on both short- and long-term inflation expectations. The right side of the chart shows the impulse-response of the long-term inflation expectations to a one standard deviation increase in uncertainty shocks. The response of the long-term inflation expectations is found to be significant. Initially, a positive uncertainty shock leads to a rise in long-term inflation expectations. In a short period of time, it starts to decelerate and dies within seven months. This finding implies that the CBRT is not fully credible since the long-term inflation expectations respond to uncertainty shocks. In other words, a rise in uncertainty shock has a direct impact on long-term inflation expectations.

On the other hand, the left side of the Graph 4 gives the impulse-response of the short-term inflation expectations to a one standard deviation increase in uncertainty shocks. A rise in uncertainty results in

deterioration in short-term inflation expectations and the effect lasts for about 7 months. Since the anchoring theory suggests that the shocks might be effective on the short-term inflation expectations, this finding does not directly tell any story about the central bank credibility. However, when we take the right side of the Graph 5 into account together with this finding, we may have the indirect effect of uncertainty shocks on long-term inflation expectations.




**Graph 5.** *Responses to a Positive Short-Term Inflation Expectation Shock in SVAR Model*

The right side of the Graph 5 depicts the effect of short-term inflation expectation shocks on long-term inflation expectations. The response of the long-term inflation expectations to a rise in short-term inflation expectations is positive and initially high. Then it decelerates within time but the effects lasts for one year after the shock. This finding provides evidence in favor of the existence of indirect de-anchoring effect in Turkey: A rise in uncertainty shock has an impact on short-term inflation expectations and the short-term inflation expectations affect the long-term inflation expectations. The findings from Graph 4 and 5 together imply that the economic agents do not fully follow the CBRT's target decisions while determining the price expectations in the both short- and long-run.

We also can have similar findings through variance decomposition analysis since the uncertainty shocks contribute to the variation of short- and long-term inflation expectations. The Table 3 shows the variance decompositions of inflation expectations.

**Table 3.** *Variance Decompositions of Inflation Expectations*

| Variable | Shock | Horizon | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| $\pi^e_{S,t}$ | Uncertainty | 11.1% | 9.3% | 8.7% | 8.4% | 8.3% | 8.2% |
| | Short-term Exp. | 88.9% | 80.5% | 80.0% | 79.6% | 79.5% | 79.4% |
| $\pi^e_{L,t}$ | Uncertainty | 0% | 1.9% | 2.0% | 2.0% | 2.0% | 2.0% |
| | Short-term Exp. | 0% | 16.1% | 18.4% | 19.8% | 20.4% | 20.7% |

According to Table 3, we may see that approximately 2% of the variation in the long-term inflation expectations is explained by the uncertainty shocks within 6 months. Although this amount seems quite scant for direct de-anchoring effect, we may see that approximately 20% of this variation can be explained with short-term inflation expectations which provide

evidence in favor of indirect de-anchoring effect. We should additionally note that approximately 8% of the variation in the short-term inflation expectations is explained by uncertainty shocks.

## 6. Conclusion

Anchoring theory suggests that a central bank is fully credible if the long-term inflation expectations are well-anchored and not responsive to a shock but to the inflation targets. Therefore, long-term inflation expectations have become a key indicator of the effectiveness of the monetary policy. In this study, we investigated the anchoring effect of long-term inflation expectations by searching for whether there is a contemporaneous effect directly from the uncertainty shocks or indirectly from the short-term inflation expectations where the anchoring theory allows uncertainty shocks to affect the short-term inflation expectations.

The structural vector autoregression (SVAR) method we have employed in the study allows for some restrictions on the contemporaneous relationships between the variables under investigation which are consistent with the economic theory. Our empirical results revealed evidence in favor of the de-anchoring process in Turkey: The dynamic responses of short- and long-term inflation expectations to a positive uncertainty shock are found to be significant and last approximately within seven months. Besides direct impact of an uncertainty shock on long-term inflation expectation, we also search for the indirect effect and found that short-term inflation expectation shocks also affect the long-term inflation expectations unlike the anchoring theory suggests. Additionally, we focused the variance decomposition analysis and it indicated that the uncertainty explains approximately 8% of the variation in the short-term inflation expectations and short-term expectations can explain approximately 20% of the variation in long-term inflation expectations. These findings imply that the CBRT is not fully credible in Turkey during the period under investigation which means the economic agents do not fully follow the CBRT during the price determination process. Since the success of the monetary policy depends on the anchoring of the long-term inflation expectations, the CBRT should take crucial actions to convince the economic agents about its policy decisions and the revealed inflation targets.

## Notes

[1] This useful equation has tested for different countries by different authors. Demertzis *et al.*, (2009) used this equation to assess the credibility in Sweden, Israel and Euro Area. The paper concludes that the monetary policy has, on the whole countries stated in the analysis, been credible during the years 1999-2009 and the adoption of an inflation targeting regime has an important impact on anchoring. Lyziak (2013) employed to discuss the credibility of the Central Bank of Poland by using the equation (1). Lyziak uses two kinds of expectation data, one is proxy of financial analyst's inflation expectations and the other is of consumer's expectations. Paper assesses that financial sector's expectations regarding the inflation displays a high anchoring degree at the National Bank of Poland inflation target, while consumer's inflation expectations are driven mainly by price movements currently perceived.

[2] The survey was organized twice a month, at the first and third weeks of each month until the end of 2012, and was started to be organized once a month since 2013. In this study, for the data before 2013, the second-period expectations are used for 12 and 24-month inflation expectations. The survey covers the answers of many respondents from the real sector and finance sector. The average of the answers for different horizons refers to the expectation regarding that horizon.

3 For some other research which quantifies the economic uncertainty for Turkey see: Ermişoğlu & Kanık (2013), Erdem & Yamak (2016).

4 The maximum lag length used with lag order selection depends on the sample size and is given by 12 for 150 observations.

## Reference


Autrup, S.L., & Grothe, M. (2014). Economic surprises and inflation expectations. Has anchoring of expectations survived the crisis? *European Central Bank, Working Paper*, No.1671. Accessed: 18 December, 2018. [Retrieved from].

Başkaya, S., Kara, H., & Mutluer, D. (2008). Expectations, communication and monetary policy in Turkey. *CBRT, Working Paper*, No.08/01. Accessed: 18 December 2018. [Retrieved from].

Bauer, M.D. (2015). Inflation expectations and the news. *International Journal of Central Banking*, Vol. 11. Accessed: 12 December 2018. [Retrieved from].

Beechey, M.J., Johannsen, B.K., & Levin, A.T. (2011). Are long-run inflation expectations anchored more firmly in the EURO area than in the United States? *American Economic Journal: Macroeconomics*, 3(2), 104-129. doi. 10.1257/mac.3.2.104

Berk, J.M., & Hebbink, G. (2006). The anchoring of European inflation expectations. *DNB Working Paper*, No.116. Accessed: 01 January 2019. [Retrieved from].

Bomfim, A.N., & Rudebusch, G.D. (2000). Opportunistic and deliberate disinflation under imperfect credibility. *Journal of Money, Credit and Banking*, 32(4), 707-721. doi. 10.2307/2601179

Çiçek S., & Akar, C. (2014). Do inflation expectations converge toward inflation target or actual inflation? Evidence from expectation gap persistence. *CBRT, Central Bank Review*, 14, 15-21.

Çiçek, S., Akar, C., & Yucel, E. (2011). Türkiye'de enflasyon beklentilerinin çapalanması ve güvenilirlik, *Iktisat, Isletme ve Finans*, 26(304), 37-55.

Demertzis, M., Marcellino, M., & Viegi, N. (2009). Anchors for inflation expectations, *DBN Working Paper*, No.229. Accessed: 01 December 2018. [Retrieved from].

Erdem, H.F., & Yamak, R. (2016). Measuring the optimal macroeconomic uncertainty index for Turkey. *Economic Annals*, LXI(210), 7-22. doi. 10.2298/EK A1610007E

Ermişoğlu, E., & Kanık, B. (2013). Turkish economic policy uncertainty index. *MPRA Archive*, Paper, No.49920. [Retrieved from].

Galati, G., Poelhekke, S., & Zhou, C. (2011). Did the crisis affect inflation expectations? *International Journal of Central Banking*. 7(1), 167–207.

Garcia, J.A., & Werner, S. (2018). Inflation news and Euro area inflation expectations. *IMF Working Paper*, No.167. [Retrieved from].

Gefang, D., Koop, G., & Potter, S. (2012). The dynamics of UK and US inflation expectations. *SIRE Discussion Paper*, No.59. 10.1016/j.csda.2011.07.008

Gürkaynak, R.S., Levin, A., & Swanson, E. (2010). Does inflation targeting anchor long-run inflation expectations? Evidence from the U.S., UK, and Sweden. *Journal of the European Economic Association*, 8(6), 1208-1242. doi. 10.1111/j.1542-4774.2010.tb00553.x

Hachula, M., & Nautz, D. (2018). The dynamic impact of macroeconomic news on long-term inflation expectations. *Economics Letters*, 165(C), 39-43. 10.1016/j.econlet.2018.01.015

Jochmann, M., Koop, G., & Potter, S.M. (2010). Modelling the dynamics of inflation compensation. *Journal of Empirical Finance*, 17(1), 157-167. 10.1016/j.jempfin.2009.08.002

Kara, H., & Küçük-Tuğer, H. (2010). Inflation expectations in Turkey: Learning to be eational. *Applied Economics*, 42(21), 2725-2742. 10.1080/00036840801964559

Lemke, W., & Strohsal, T. (2013). What can break-even inflation rates tell us about the anchoring of inflation expectations in the Euro area? *Annual Conference 2013*, Duesseldorf. [Retrieved from].

Lyziak, T., & Paloviita, M. (2016). Anchoring of inflation expectations in the Euro area: Recent evidence based on survey data. *European Central Bank, Working Paper*, No.1945. [Retrieved from].

Mehrotra, A.N., & Yetman, J. (2014). Decaying expectations: What inflation forecasts tell us about the anchoring of inflation expectations. *BIS Working Paper*. No.464. [Retrieved from].

Narayan, S. (2013). A structural VAR model of the Fiji Islands. *Economic Modelling*, 31, 238-244. doi. 10.1016/j.econmod.2012.11.014

Nautz, D., Netsunajev, A., & Strohsal, T. (2016). The anchoring of inflation expectations in the short and in the long run. *SFB 649 Economic Risk, Discussion Paper*, No.2016-015. 10.1017/s1365100517000517

Sims, C.A. (1980). Macroeconomics and reality. *Econometrica*, 48(1), 1-48. doi. 10.2307/1912017

Tsenova, T. (2012). Are long-term inflation expectations well-anchored? Evidence from the Euro area and the United States. *Bulgarian National Bank, Bulletin of Economic Research* No.67-1. [Retrieved from].

Yellen, J.L. (2015). Inflation dynamics and monetary policy. *Speech at the Philip Gamble Memorial Lecture, University of Massachusetts*, Amherst, Massachusetts, 2015-09-24. [Retrieved from].

Yıldırım, H. & Alkan, B. (2018). Türkiye için bir makroekonomik belirsizlik endeksi önerisi, *TBB, Bankacılar Dergisi*, 104, 6-24.